Unconstrained Minimum of a function: Spring Cart Problem

Reference:

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Problem:
Figure 2.4 shows two frictionless rigid bodies (carts) A and B connected by three linear elastic springs having spring constants k1, k2, and k3. The springs are At their natural positions when the applied force P is zero. Find the displacements x1 and x2 under the force P by using the principle of minimum potential energy.

Mathematical Formulation:

According to the principle of minimum potential energy, the system will be in equilibrium under the load P if the potential energy is a minimum. The potential energy of the system is given by
potential energy (U) = strain energy of springs − work done by external forces

$$U(x)= [(½)k2x1^2 + (½)k3(x2 − x1)^2 + (½)\ k1\ x2^2\ ] − Px2$$

How to use the code:

- The user is asked to enter the value of the force being applied. Here, it is taken to be 100.
- The user then needs to enter the value of spring constant. The value of k1 is 1 here.
- Similarly, the user needs to specify the value of second and third spring constant ie k2 and k3 . Here, they are 2 and 1 respectively.
- As the values are provided, the function is executed and the output is displayed. It gives the displacement of the cart and the minimum value of potential energy.

Function to be used:

[x,fval] = fminsearch (costf , x0 , options)

Costf : a function or a list, the objective function. This function computes the value of the cost function.
x0 : a matrix of doubles, the initial guess.
Options : A struct which contains configurable options of the algorithm (see below for details).
X :The minimum.
Fval :The minimum function value.
Exitflag : The flag associated with exist status of the algorithm.
The following values are available.
-1
The maximum number of iterations has been reached.

0
The maximum number of function evaluations has been reached.
1
The tolerance on the simplex size and function value delta has been reached. This signifies that the algorithm has converged, probably to a solution of the problem.